



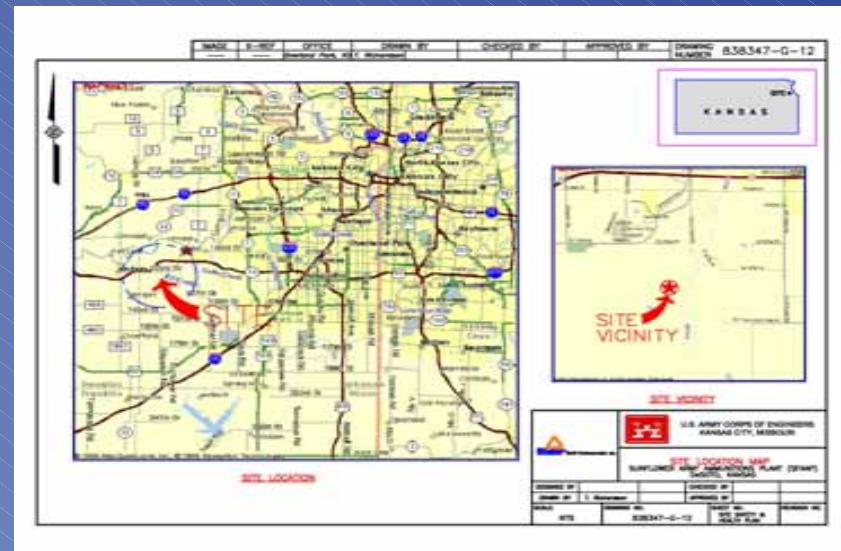
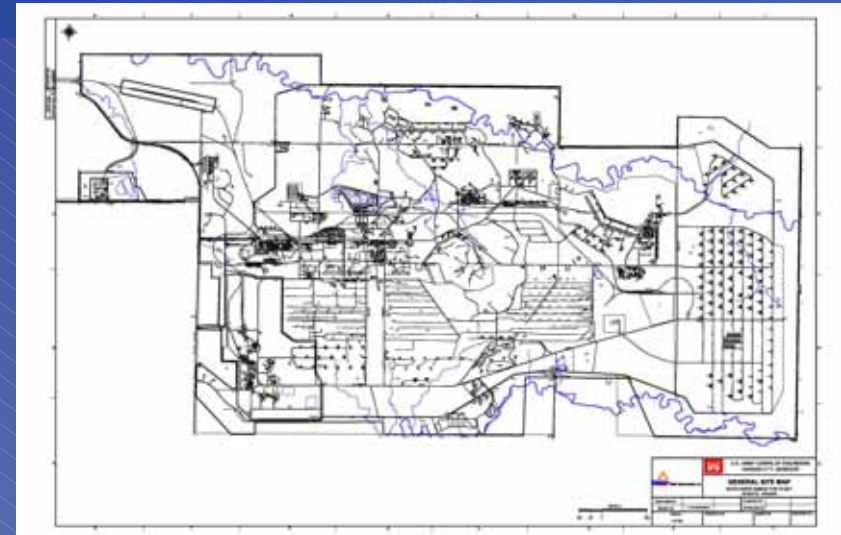
Shaw The Shaw Group Inc.

Sampling of Potentially Explosive Contaminated Soils Utilizing Remote Direct Push Technology

**Siva Sivalingam, Ph.D (Shaw); Paul Lear, Ph.D
(Shaw); Kevin Neal, CHMM (Shaw); Robert Elder, PG
(Shaw); Ian Sangster (Shaw); Charles Colbert, P.E,
CIH (USACE); Timothy Shepard, Ph.D (USACE); Bill
Wilson (PSA Environmental)**

Sunflower Army Ammunition Plant

- ➡ 9,063 acres acquired near DeSoto, KS in 1941
- ➡ Used by the U.S. Army to manufacture propellants
- ➡ Declared excess to the U.S. Army's needs in 1997
- ➡ Decontamination/Demolition/Remediation required for approx. 2,824 acres
- ➡ State of Kansas is considering mixed use, general development of the site



Propellant Manufacturing at SFAAP

- ➡ Nitroglycerine (NG)
- ➡ Nitrocellulose (NC)
- ➡ Nitroguanidine (NQ)
- ➡ Solvent-less double based propellants for rockets
- ➡ Solvent single base, double base, and triple base propellants for small arms and cannon
- ➡ Solvent double base rocket propellants
- ➡ Base grain for casting propellants



Propellant Manufacturing at SFAAP

➡ Years of Production

- NC 1943-1960, 1965-1971
- NG 1943-1948, 1951-1960, 1965-1971
- NQ 1984-1992
- Propellants 1943-1948, 1951-1960, 1965-1971



Propellant Production at SFAAP

- ➡ N-5 propellant is an example
 - a mixture of nitroglycerine, nitrocellulose, diethylphthalate, 2-dinitrophenylamine, lead 2-ethylhexoate, lead salicylate, and candelilla wax)



Propellant Production at SFAAP

☞ The N-5 was rolled into sheets and extruded into solid propellant grains



Propellant Production at SFAAP

- ☞ Production plant washdown water, containing N-5 propellant paste and chips were discharged into ditches and settling ponds
- ☞ Excess propellant materials from manufacturing and finishing taken to the Burn Area (SWMU 22)



NG Production

- ➡ NG was produced at SFAAP by reacting glycerin with nitric/sulfuric acid
- ➡ The NG was separated from the acid and washed/neutralized to remove excess acid



NG Production

- ➡ The water used to wash/neutralize the NG was collected and any residual NG allowed to settle out prior to discharge of the water into drains and surface ditches
- ➡ This NG was collected for disposal



NG Production



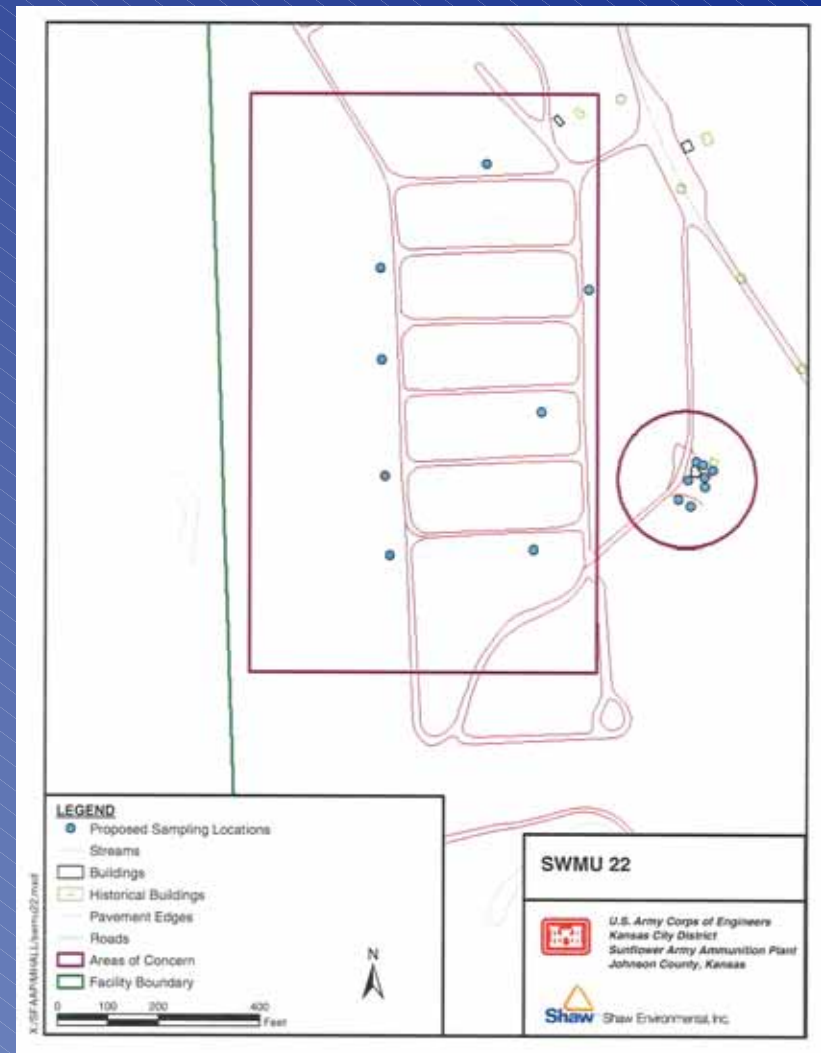
Nitroglycerine Slums

- ➡ Waste NG from the bottom of the wash water tanks was collected daily
- ➡ 11.25 lbs. triacitin or diesel was mixed with 3.75 lbs. NG, then sawdust added until no free liquid
- ➡ NG slums are containerized in bags and transported to Burn Area
- ➡ At open burn area, bags are inspected to ensure no free liquids and placed in nitroglycerine slums dumping/burning area



Burn Area (SWMU 22)

- ➡ A 30-acre site
- ➡ 6 burning cells (9 acres)
- ➡ An explosive waste staging area
- ➡ A NG slums dumping/burning area
- ➡ Final destruction area for all propellant-based wastes generated on plant from 1943 to 1980
- ➡ Requires remediation of metals and explosives; sampling required to determine extent of remediation



Sampling of the NG Slums Dumping Area

- ➡ Remote sampling where concentrations of NG are expected to be the greatest
- ➡ Field screening using EnSys field test kits to determine if propellant contamination levels are less than 10 percent by volume
- ➡ If greater than 10%, field activities would be halted
- ➡ If less than 10%, non-remote sampling will be performed.

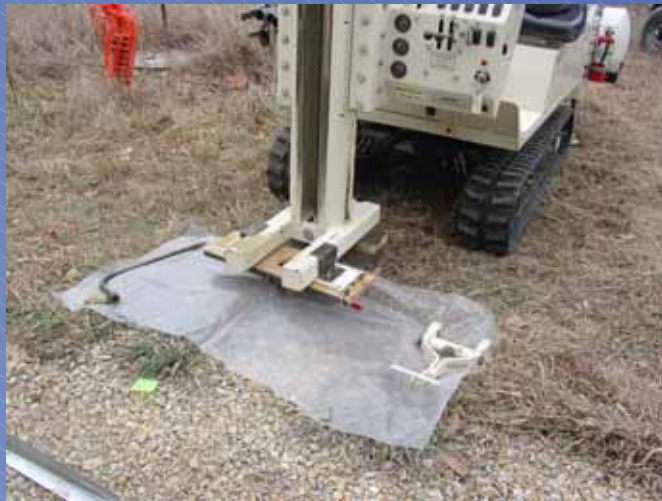


Why Remote Sampling?

- ➡ Radford Army Ammunition Plant had an explosion in their NG Slums Burning Area
- ➡ Probable cause was pooling of NG within the soil
- ➡ Potential existed for NG pooling at SFAAP
- ➡ Recommendation from Army and USACE personnel was that a 500-foot buffer zone be utilized from the drill rig

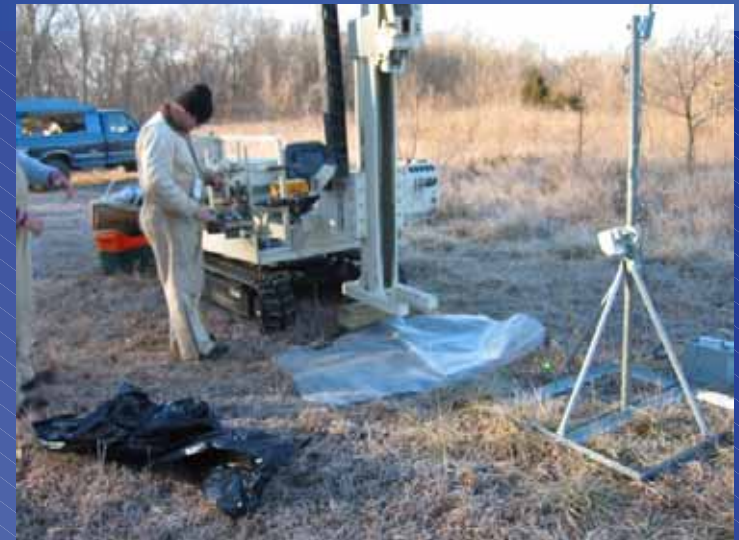
Remote DPT Rig

- ☞ Standard tracked Geoprobe rig
- ☞ Operator can remotely start and operate
- ☞ Modified to automatically slice acetate sleeve



Remote DPT Rig

- ➡ “Video game”-like operation
- ➡ Camera and transmitter located near DPT rig
- ➡ Receiver and television located 400 feet away



Remote DPT Drilling

- ➡ Drilled 4 holes down to bedrock (approximately 18-20 feet)
- ➡ Total of 20 4-foot cores
- ➡ No detonations or deflagrations occurred



On-Site Analysis

- ☞ Real-time analysis in a mobile laboratory trailer
- ☞ EnSys field test kits for nitrated explosives
 - Extraction in acetone
 - Color development with NitriVer powder
 - Measure absorbance in spectrophotometer
- ☞ XRF analysis for lead
 - Dry soil on hot plate
 - Screen soil and compact in sample cup
 - Measure lead in Niton XRF



On-Site Analysis

- ➡ Highest NG concentration found was near 300 mg/kg
 - Well below 100,000 mg/kg (10% by volume)
- ➡ Lead levels were less than 400 mg/kg



Summary

- ☞ Sampling of the NG Slums Burning Area required to determine extent of contamination
- ☞ Potential presence of NG at explosive levels mandated remote sampling
- ☞ Remote DPT sampling rig allowed remote sampling without incident
- ☞ On-site analysis determined that NG and lead contamination in the NG Slums Burning Area was minimal